

CONTENTS

| | |
|--|-----|
| PREFACE | vii |
| OVERVIEW | |
| An overview on the passivity of metals N. Sato | 1 |
| Passivation of semiconductors T. Sugano | 21 |
| FUNDAMENTALS OF PASSIVATION | |
| Electrochemical methods in passivity study S. Haruyama | 29 |
| A simple man's view of the passivation of semiconductors J. A. Van Vechten | 39 |
| The electronic properties and control of semiconductor interfaces J. M. Woodall, P. D. Kirchner, J. L. Freeout and A. C. Warren | 53 |
| ELECTRONIC DEVICES AND PASSIVATION | |
| Passivity and corrosion of electronic materials and devices R. P. Frankenthal | 59 |
| Fluorine passivation of stainless steel N. Miki, M. Maeno, K. Maruhashi, Y. Nakagawa and T. Ohmi | 69 |
| The atmospheric corrosion of Co-Cr alloy films H. Hagi, T. Nagata and Y. Hayashi | 75 |
| On the interpretation of photoelectrochemical experiments with passive layers on metals H. Gerischer | 81 |
| CHARACTERIZATION | |
| Surface analysis of the passive state I. Olefjord and L. Wegrelius | 89 |
| In situ observation of stainless steel surface in aqueous solution using scanning tunneling microscope A. Miyasaka and H. Ogawa | 99 |
| Glancing angle X-ray studies of oxide films A. J. Davenport and H. S. Isaacs | 105 |
| STRUCTURE AND COMPOSITION | |
| The use of X-ray absorption spectroscopic techniques to study the influence of alloying elements on passive films J. Kruger, G. G. Long, Z. Zhang and D. K. Tanaka | 111 |
| Characterization of passive films on Ni and Ni alloys by ReflEXAFS and Raman spectroscopy R. Cortes, M. Froment, A. Hugot-Le Goff and S. Joiret | 121 |
| New advances in the investigation of passivation mechanisms and passivity by combination of a.c. relaxation techniques: Impedance, RRDE and quartz electrogravimetry C. Gabrielli, M. Keddam and H. Takenouti | 129 |
| Composition and growth of anodic oxide films on iron M. J. Graham, J. A. Bardwell, R. Goetz, D. F. Mitchell and B. MacDougall | 139 |
| A SIMS study of reactions in the metal-oxygen-hydrogen-water system G. Hultquist, G. K. Chuah and K. L. Tan | 149 |

| | |
|---|-----|
| The dependence of refractive index and thickness of iron passive films upon the oxidation condition | |
| T. Ohtsuka, K. Azumi and N. Sato | 155 |
| In-situ ellipsometric determination of thickness and optical constants of passive and transpassive films on Alloy 600 in neutral solution | |
| S. Matsuda, T. Kikuchi and K. Sugimoto | 161 |
| XPS and UPS examinations of passive layers on Ni and Fe-53Ni alloys | |
| H.-W. Hoppe and H.-H. Strehblow | 167 |
| An XPS and electrochemical study of the influence of molybdenum and nitrogen on the passivity of austenitic stainless steel | |
| R. D. Willenbruch, C. R. Clayton, M. Oversluizen, D. Kim and Y. Lu | 179 |
| AES analysis of pits and passive films formed on Fe-Cr, Fe-Mo and Fe-Cr-Mo alloys | |
| A. Schneider, D. Kuron, S. Hofmann and R. Kirchheim | 191 |

METHODS FOR PASSIVITY STUDY

| | |
|---|-----|
| In situ analysis of passive films by potential modulated uv-visible reflection spectroscopy | |
| N. Hara and K. Sugimoto | 197 |
| Ion backscattering, channeling and nuclear reaction analysis study of passive films formed on FeCrNi and FeCrNiMo (100) single crystals | |
| C. Cohen, D. Schmaus, A. Elbiache and P. Marcus | 207 |
| Electronic and optical properties of radiated oxide films on valve metals | |
| J. W. Schultze, L. Elfenthal, G. Hansen, T. Patzelt, B. Siemensmeyer and J. Thietke | 213 |
| SALI analysis of passive films on nickel alloys | |
| D. D. Macdonald, M. Ben-Haim and J. Pallix | 223 |

METALS AND ALLOYS

| | |
|---|-----|
| Aluminum pitting in chloride solutions: Morphology and pit growth kinetics | |
| M. Baumgärtner and H. Kaesche | 231 |
| Structure of amorphous anodic oxide films on aluminum | |
| M. Kobayashi and Y. Niioka | 237 |
| The role of anions in the formation of hydroxide films on aluminum in hot aqueous solutions | |
| H. Takahashi, M. Yamaki and R. Furuichi | 243 |
| The observation of anodic oxide films on aluminum by high resolution electron microscopy | |
| S. Ono, H. Ichinose, T. Kawaguchi and N. Masuko | 249 |
| Effects of hydrogen sulphide and temperature on the passivation behaviour of titanium | |
| A. Rauscher, G. Kutscha and Z. Lukács | 255 |
| Passivity and its breakdown on zirconium in high temperature nitric acid | |
| H. Kajimura and H. Nagano | 261 |
| Investigation of the kinetics of growth of anodic oxide films on niobium by galvanostatic and tensiodynamic experiments | |
| F. Di Quarto, S. Piazza and C. Sunseri | 267 |
| The effect of oxidizing ions on passivity of the valve metals in boiling nitric acid solutions | |
| T. Fujii and H. Baba | 275 |
| The states of bromides on titanium surface prior to pit initiation | |
| S.-Z. Huo and X.-X. Meng | 281 |
| Passivation and its stability of copper in alkaline solutions containing carbonate and chloride ions | |

| | |
|---|-----|
| A. Nishikata, M. Itagaki, T. Tsuru and S. Haruyama | 287 |
| A study of the initial stages in oxidation of copper in alkaline solutions | |
| M. Shirkhanzadeh, G. E. Thompson and V. Ashworth | 293 |
| In-situ gravimetry of passivation of copper by means of quartz crystal microbalance | |
| L. Grasjo, M. Seo and N. Sato | 299 |
| Application of superimposed equilibrium diagrams for the passivity of zinc in aqueous solutions containing chromate, molybdate and tungstate | |
| D. Bijimi | 305 |
| Study of chromate coatings on zinc by means of d.c., a.c. and gravimetric methods in alkaline electrolyte : Correlation to humid-storage test and to Cr VI content of the conversion film | |
| J. Hazan, C. Coddet and M. Keddam | 313 |
| Piezoelectric response to surface stress change of iron and copper electrodes covered with oxide films | |
| X.-C. Jiang, M. Seo and N. Sato | 319 |
| AMORPHOUS AND CORROSION-RESISTANT ALLOYS | |
| Passivity of metal-metalloid glasses | |
| M. Janik-Czachor | 325 |
| Passivity, breakdown and repassivation of glassy Fe-Cr-P alloys | |
| S. Virtanen and H. Böhni | 333 |
| The effect of structural relaxation on the passivation behavior of amorphous Fe-Cr-W-P-C alloys | |
| H. Habazaki, A. Kawashima, K. Asami and K. Hashimoto | 343 |
| Passivity and its breakdown on sputter-deposited amorphous Al-early transition metal alloys in 1 M HCl at 30°C | |
| H. Yoshioka, Q. Yan, H. Habazaki, A. Kawashima, K. Asami and K. Hashimoto | 349 |
| The stability of passive state of melt-spun amorphous chromium-base alloys | |
| A. Kawashima, B.-P. Zhang, H. Habazaki, K. Asami and K. Hashimoto | 355 |
| Breakdown and repassivation of passive films on iron whisker and amorphous alloys | |
| T. Tsuru and M. Sakairi | 361 |
| Corrosion behaviour of molybdenum-implanted stainless steel | |
| M. B. Ives, U. G. Akano, Y. C. Lu, G. Ruijin and S. C. Srivastava | 367 |
| The antagonistic roles of chromium and sulphur in the passivation of Ni-Cr-Fe alloys studied by XPS and radiochemical techniques | |
| P. Marcus and J. M. Grimal | 377 |
| The behavior of phosphorus during passivation of weathering steel by protective patina formation | |
| H. Kihira, S. Ito and T. Murata | 383 |
| The effect of dry passivation treatments on the corrosion resistance, moisture release and structure of the surface oxide film on electropolished stainless steel | |
| H. Tomari, F. Satoh, M. Terada, H. Satoh, T. Ohmi and Y. Nakahara | 389 |
| The improvement of passivity by ion implantation | |
| Sh. Song, W. Song and Zh. Fang | 395 |
| Passivity and its breakdown on sputter-deposited amorphous Al-Ti alloys in a neutral aqueous solution with Cl ⁻ | |
| Q. Yan, H. Yoshioka, H. Habazaki, A. Kawashima, K. Asami and K. Hashimoto | 401 |
| Sol and gel formations in reactions of amorphous titania with H ₂ O ₂ and HNO ₃ | |
| K. Nakano, K. Matsuo, K. Tomono and N. Nakahara | 407 |

PASSIVITY BREAKDOWN

| | |
|---|-----|
| Stochastic studies of passivity breakdown | 413 |
| T. Shibata | |
| Deterministic models for passivity breakdown | 425 |
| D. D. Macdonald and M. Urquidi-Macdonald | |
| Chloride ion effects on passive films on FeCr and FeCrMo studied by AES, XPS and SIMS | 431 |
| D. Landolt, S. Mischler, A. Vogel and H. J. Mathieu | |
| Repassivation method to determine critical conditions in terms of electrode potential, temperature and NaCl concentration to predict crevice corrosion resistance of stainless steels | 441 |
| S. Tsujikawa and S. Okayama | |
| A multistep birth and death model for local breakdown of passivity | 447 |
| B. Baroux | |
| Two-step initiation hypothesis of pitting corrosion in passive metals | 453 |
| T. Okada | |
| Criteria for passivity breakdown of high alloy materials in relation to crevice corrosion nucleation | 459 |
| H. Ogawa, K. Denpo and A. Miyasaka | |
| An analysis of current fluctuations during passive film breakdown and repassivation in stainless alloys | 465 |
| Y. Miyata, T. Handa and H. Takazawa | |
| Passivity and passivity breakdown in nickel aluminide | 471 |
| U. Bertocci, J. L. Fink, D. E. Hall, P. V. Madsen and R. E. Ricker | |
| The effects of passive films formed on iron, nickel and austenitic stainless steels (SUS 304 and 316) on pitting corrosion | 479 |
| R. Nishimura and K. Kudo | |
| The effect of electrolyte composition on the pitting and repassivation behavior of AISI 304 stainless steel at high temperature | 485 |
| H. Yashiro and K. Tanno | |
| An impedance study of the passivity breakdown during stress corrosion cracking phenomena | 491 |
| M. C. Petit, M. Cid, M. Puiggali and Z. Amor | |
| In-situ analysis of chloride ion concentration within pits during pitting of iron | 497 |
| T. Mizuno | |
| Analysis of corrosion potential noise for stress corrosion cracking | 503 |
| K. Yamakawa and H. Inoue | |
| Characteristics of pit growth on aluminium in seawater | 509 |
| D. Weng and S.-Z. Huo | |

STAINLESS STEELS

| | |
|--|-----|
| The effect of marine fouling on the ennoblement of electrode potential for stainless steels | 515 |
| S. Motoda, Y. Suzuki, T. Shinohara and S. Tujikawa | |
| Cathodic reduction of oxygen on stainless steels in a neutral solution | 521 |
| M. Okuyama and S. Haruyama | |
| Changes in the power spectral density of noise current on Type 304 stainless steel during the long time passivation in sulfuric acid solutions | 527 |
| K. Tachibana, K. Miya, K. Furuya and G. Okamoto | |
| Dissolution rates of iron and chromium and Fe-Cr alloys in the passive state | 533 |
| B. Heine and R. Kirchheim | |
| Passivation of Ni-Cr-Mo alloys in chloride solution : A new kinetics model | 539 |
| N. Jallerat and K. VU Quang | |

| | |
|--|-----|
| Passivity and breakdown of passivity of iron-chromium alloys studied with cyclic voltammetry, ellipsometry and XPS | |
| J. H. Gerretsen, J. H. W. de Wit and J. C. Rivière | 545 |
| The pitting behaviour of Ni-Cr-Fe-Mo alloys | |
| B. E. Clark, S. J. Thorpe and K. T. Aust | 551 |
| The relationship between the characteristics of oxide film and stress corrosion susceptibility of Ni-Cr-Fe alloy in high temperature water | |
| H. Hirano, H. Takaku and T. Kurosawa | 557 |
| Passivity breakdown : Its relation to pitting and stress-corrosion-cracking processes | |
| J. R. Galvele, R. M. Torresi and R. M. Carranza | 563 |
| Compositional changes of passive films due to different transport rates and preferential dissolution | |
| R. Kirchheim | 573 |
| The corrosion behavior of stainless steels in aqueous ethanol solution containing sulfuric acid | |
| I. Sekine, M. Yuasa and K. Kohara | 579 |
| Role of oxyanions in the improvement of the stainless steels passivity | |
| C. Lemaitre, B. Baroux and G. Beranger | 585 |
| Effect of water ageing on semiconducting properties of passive films formed on a stainless steel by annealing in hydrogen atmosphere | |
| D. Gorse, B. Rondot and B. Baroux | 591 |

KINETICS OF PASSIVATION

| | |
|--|-----|
| Growth and dissolution of passivating films | |
| K. E. Heusler | 597 |
| The passivation of newly generated surface and kinetics of anodic dissolution of nickel | |
| T. Agladze, I. Kolotyrkin and L. Janibakhchieva | 607 |
| Potential/current oscillations and anodic film characteristic of iron in concentrated chloride solutions | |
| W. Li, K. Nobe and A. J. Pearlstein | 615 |
| Computer simulation of alloy passivation and activation | |
| Q. Song, R. C. Newman, R. A. Cottis and K. Sieradzki | 621 |
| A-C response of RRDE during the passivation of iron | |
| N. Benzekri, R. Carranza, M. Keddam and H. Takenouti | 627 |
| A detailed analysis of impedance measurements in the study of the passivation of chromium | |
| J. A. L. Dobbelaar and J. H. W. de Wit | 637 |
| The step response function of anodic reaction induced by rapid strain-ing on passive metals | |
| S. Fujimoto and T. Sibata | 643 |
| The study of the stability of passive films using potentiostatic-galvanostatic transient technique | |
| Sh. Song and Ch. Cao | 649 |
| Passivation of iron and its cathodic reduction studied with rotating ring-disk electrode | |
| T. Tsuru, E. Fujii and S. Haruyama | 655 |
| The application of the hopping motion theory to reduction of the Fe(III) oxide in the iron/bicarbonate solution system | |
| C. V. D'Alkaine and J. M. da Silva | 661 |
| Characterization of vacancy transport in passive films using low frequency electrochemical impedance spectroscopy | |
| D. D. Macdonald and S. I. Smedley | 667 |

ELECTRONIC AND OPTICAL PROPERTIES OF PASSIVE FILM

| | |
|--|--|
| The impedance characteristics of passive films on iron | |
|--|--|

| | |
|---|-----|
| K. Noda, T. Tsuru and S. Haruyama | 673 |
| Semiconductor properties of passive films on Zn, Zn-Co, and Zn-Ni substrates and ZnO single crystals | |
| J. R. Vilche, K. Jüttner, W. J. Lorenz, W. Kautek, W. Paatsch, M. H. Dean and U. Stimming | 679 |
| Irradiation effects in anodic oxide films formed on titanium studied by photoelectrochemistry | |
| D. Gorse, B. Rondot and Y. Serruys | 685 |
| The effects of polarization potential and concentration of hydrochloric acid on photopotential of passive film formed on titanium in hydrochloric acid solution | |
| M. Hara and Y. Shinata | 691 |
| Photoelectrochemical and radiochemical investigation of oxide layers | |
| W. Plieth, H.-J. Rieger, H. Yang, G. Marx, L. Helmke and W. Schönemann | 697 |
| The formation of anodic sulfide films on tin electrodes | |
| E. D. Bidôia and L. O. de S. Bulhoes | 703 |
| A conductive film model for the lead anode in sulfuric acid | |
| S. B. Hall and G. A. Wright | 709 |
| Analysis of transient photocurrent measured on passivated iron electrodes | |
| K. Azumi, T. Ohtsuka and N. Sato | 715 |
| A photocurrent spectroscopic investigation of passive films on chromium | |
| F. Di Quarto, S. Piazza and C. Sunseri | 721 |
| A photoelectrochemical and ESCA study of passivity of amorphous nickel-valve metal alloys | |
| K. Asami, S.-C. Chen, H. Habazaki, A. Kawashima and K. Hashimoto | 727 |
| The n-type - p-type photoresponse transition of Mg-doped and Zn-doped polycrystalline iron oxide electrode | |
| C.-M. Cai, R.-T. Tong, D.-L. Jiang and A. Fujishima | 733 |
| Study of passive films on stainless steels by photocurrent measurements | |
| A. Di Paola | 739 |
| Photocurrents on passive and active-passive metals | |
| T. D. Burleigh | 745 |

ROUND TABLE DISCUSSION

| | |
|--|-----|
| <u>Present Status and Prospects of Corrosion Science and Engineering</u> | 751 |
| Present state and future problems of corrosion science and engineering | |
| K. E. Heusler | 753 |
| DISCUSSION | 763 |
| AUTHOR INDEX | 769 |
| SUBJECT INDEX | 775 |

